

What is claimed:

1 1. A dielectric layer (12) disposed on the surface (14) of a substrate
2 (16), the dielectric layer having a top surface (18), wherein the dielectric layer
3 comprises a first dielectric gradient region (26, 44) in which a dielectric constant k
4 decreases continuously from a maximum value to a minimum value with distance from
5 the substrate surface.

1 2. The dielectric layer (12) according to claim 1 wherein an
2 instantaneous rate of decrease of k in the first dielectric gradient region (26) is between
3 0.025 and 0.5 per 10 nm of the dielectric thickness (13) at substantially every location
4 throughout the first dielectric gradient region (26).

1 3. The dielectric layer (12) according to claim 1 wherein an
2 instantaneous rate of decrease of k in the first dielectric gradient region (26) is between
3 0.05 and 0.1 per 10 nm of the dielectric thickness (13) at substantially every location
4 throughout the first dielectric gradient region (26).

1 4. The dielectric layer (12) according to claim 1 wherein the
2 minimum value of k in the first dielectric gradient region (26) represents a reduction of
3 at least 0.2 relative to the maximum value.

1 5. The dielectric layer (12) according to claim 1 wherein the
2 minimum value of k in the first dielectric gradient region (26) represents a reduction of
3 at least 0.5 relative to the maximum value.

1 6. The dielectric layer (12) according to claim 1 wherein the
2 instantaneous rate of decrease of k in the first dielectric gradient region (26) varies
3 linearly with distance from the substrate surface (14).

1 7. The dielectric layer (12) according to claim 1 wherein the
2 instantaneous rate of decrease of k in the first dielectric gradient region (26) varies
3 nonlinearly with distance from the substrate surface (14).

1 8. The dielectric layer (12) according to claim 1 wherein the first
2 dielectric gradient region (26) is adjacent the substrate surface (14).

1 9. The dielectric layer (12) according to claim 1 wherein the first
2 dielectric gradient region (26) is not adjacent the substrate surface (14), the dielectric
3 layer (12) further comprising an initial dielectric region (24) bounded by the substrate
4 surface (14) and the first dielectric gradient region (26).

1 10. The dielectric layer (12) according to claim 1 wherein the first
2 dielectric gradient region (26) consists essentially of chemical vapor deposition
3 products.

1 11. The dielectric layer (12) according to claim 1 wherein the
2 dielectric layer consists essentially of chemical vapor deposition products.

1 12. The dielectric layer (12) according to claim 1 wherein the
2 dielectric layer further comprises a second dielectric gradient region (30, 38, 46) in
3 which k increases continuously with distance from the substrate surface (14).

1 13. The dielectric layer (12) according to claim 12 wherein the second
2 dielectric gradient region (30, 38, 46) forms the top surface (18) of the dielectric layer
3 (12).

1 14. The dielectric layer (12) according to claim 12 wherein the
2 dielectric layer further comprises a third dielectric gradient region (34) in which k
3 decreases continuously with distance from the substrate surface (14), the third
4 dielectric gradient region being farther than the second dielectric gradient region (30)
5 from the substrate surface.

1 15. The dielectric layer (12) according to claim 14 wherein the third
2 dielectric gradient region (34) is adjacent the second dielectric gradient region (30).

1 16. The dielectric layer (12) according to claim 14 wherein the third
2 dielectric gradient region (34) is not adjacent the second dielectric gradient region
3 (30), the dielectric layer further comprising an intermediate dielectric region (32)
4 bounded by the second dielectric gradient region (30) and the third dielectric gradient
5 region (34).

1 16. A semiconductor device comprising a dielectric layer (12)
2 according to claim 1.

1 17. A process of making a dielectric layer (12) disposed on the surface
2 (14) of a substrate (16), the process comprising applying directly or indirectly to the
3 substrate, under chemical vapor deposition conditions, a continuously varying
4 composition of chemical vapor deposition precursors to form a first dielectric gradient
5 region (26) in which a dielectric constant k decreases continuously from a maximum
6 value to a minimum value with distance from the substrate surface.

1 18. The process of claim 17 further comprising applying to the
2 substrate an initial dielectric region (24) and then applying the first dielectric gradient
3 region (26) to the substrate.

1 19. A process of making a semiconductor device that comprises a
2 dielectric layer (12) disposed on a surface (14) of a substrate (16), the process
3 comprising applying directly or indirectly to the substrate, under chemical vapor
4 deposition conditions, a continuously varying composition of chemical vapor deposition
5 precursors to form a first dielectric gradient region (26) in which a dielectric constant k
6 decreases continuously from a maximum value to a minimum value with distance from
7 the substrate surface.

1 20. The process of claim 19 further comprising applying to the
2 substrate an initial dielectric region (24) and then applying the first dielectric gradient
3 region (26) to the substrate.